HUMAN HEALTH PROBLEMS ASSOCIATED WITH MEVINPHOS (PHOSDRIN) IN CALIFORNIA FOR THE YEARS 1975 THROUGH 1977

By

S.A. Peoples, Medical Consultant
Keith T. Maddy, Staff Toxicologist
Susan Edmiston, Agricultural Inspector

HS-373 Revised April 1, 1978

California Department of Food and Agriculture
Division of Pest Management, Environmental
Protection and Worker Safety
Worker Health and Safety Branch
1220 N Street, Sacramento, California 95814

HUMAN HEALTH PROBLEMS ASSOCIATED WITH MEVINPHOS (PHOSDRIN) IN CALIFORNIA FOR THE YEARS 1975 THROUGH 1977

S. A. Peoples, M.D., Medical Consultant
Keith T. Maddy, D.V.M., M.P.H., Staff Toxicologist
Susan Edmiston, Agricultural Inspector

Worker Health and Safety Unit
Division of Pest Management, Environmental
Protection, and Worker Safety
California Department of Food and Agriculture
1220 N Street, Sacramento, California 95814

SUMMARY

In California, although there are records of only 3 deaths attributed to exposure to the agricultural insecticide mevinphos (Phosdrin) since 1961, more than 50 serious systemic poisonings per year have been reported as occurring from occupational exposure. When mixed and loaded by hand-pouring procedures, mevinphos is too hazardous for use. For the applicator, the dermal exposure hazards to droplet and mist is high. At any time the workplace temperature is above 85° F., hazard to the applicator is particularly high because it is too uncomfortable to wear enough protective clothing. The field use experience with this pesticide indicates that the only way it might be used with some degree of safety would be to: (1) require closed mixing and loading systems to protect mixers and loaders, (2) limit use to times when air temperatures are less than 85° F., (3) require a minimum of 48 hours worker-reentry interval for all field applications to protect field workers who would subsequently enter those fields and handle previously treated foliage, and (4) specify that Phosdrin only be used when safer alternate chemicals will not give adequate pest control. It is recommended that these actions be taken by implementing appropriate regulations.

HS-373 (Revised April 1, 1978)

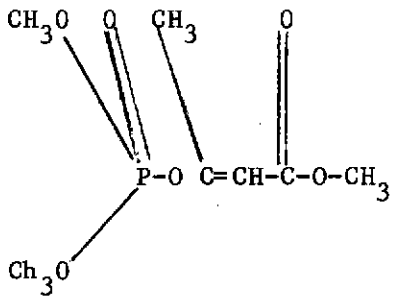
INTRODUCTION

Technical or chemical name: 2-Carboxmethoxy-1-methylvinyl dimethyl phosphate, alpha isomer

Common name: mevinphos

Examples of trade names: Phosdrin, Duraphos, Castle X-4, Vegephos 4

Chemical structure and formula:



$C_7H_{13}O_6P$

Molecular weight: 224

Chemical properties: Pale yellow liquid; boiling at 99-103° C (0.03 mm Hg).

Solubility: Miscible in water as well as most organic solvents.

Vapor pressure: 0.0029 mm Hg at 70° F.

Toxicity data: EPA toxicity category - one (1).

Acute oral LD_{50} (rat) - 3.7 to 6 mg mevinphos/kg
Acute dermal LD_{50} (rat) - 4.2 to 4.7 mg mevinphos/kg
Chronic oral (rat) - the minimum lethal dose is between 100 and 200 ppm Phosdrin insecticide; sublethal doses continually lower cholinesterase levels.
Vapor exposure - LD_{50} (rat) is approximately 14 ppm Phosdrin insecticide.
TLV - 0.1 mg/m^3

Use: A systemic insecticide-acaricide with short residual activity. Recommended to control more than 30 common insects and mites on more than 46 different crops.

Biological Action: A direct inhibitor of acetylcholinesterase; readily absorbed through the skin, lungs, and mucous membranes. It has no long-term adverse effect on soil microorganisms, and it does not accumulate in the soil.

Application methods: It is applied as a spray by conventional hydraulic ground-rig sprayers, and airplane sprayers, or as a dust by ground application vehicle and aircraft. It is applied in quantities of 1/8 to 2 lbs. actual mevinphos per acre.

Combinations with other pesticides: Compatible with most insecticides and fungicides, except strongly alkaline materials.

FORMULATIONS OF MEVINPHOS (PHOSDRIN)

Technical mevinphos (Phosdrin) contains not less than 60 percent of the alpha isomer, with the remainder being insecticidally related compounds. Mevinphos is marketed in formulations ranging from the most concentrated (the technical material) to the most dilute (a 1% dust).

The most concentrated formulation of mevinphos on the market is a water soluble insecticide containing 10.3 pounds of mevinphos per gallon. This formulation contains 60 percent of the alpha isomer and 40 percent related compounds. This formulation is registered for use on fruit, field, vegetable, and nut crops.

The formulation with the largest number of registrations is the emulsifiable liquid containing 4 pounds of mevinphos per gallon. The percentage of mevinphos in these formulations ranges from 50.6 percent (Soilserv, Inc.) down to 46.0 percent (Puregro Co., AMVAC Chemical Corporation). Many of these emulsifiable liquids contain xylene as a solvent, which in itself is quite toxic, and which makes the formulation more hazardous to use. Other solvents for this formulation include isopropyl alcohol (which is ordorless), petroleum solvents, and other petroleum derivatives.

Mevinphos is also marketed as a miscible liquid insecticide containing 4 pounds mevinphos per gallon. Solvents used for this formulation include petroleum hydrocarbons and isopropyl alcohol.

Mevinphos is marketed as a dust; by itself or in combination with other pesticides such as Diazinon, sulfur, Bacillus thuringiensis Berliner, and zinc ethylene bisdithiocarbamate. These formulations usually are 1, 1.5, or 2 percent mevinphos by weight.

FATAL CASES - 1961 THROUGH 1976

A summary of the fatal cases known to have involved mevinphos exposure (Phosdrin) in California follows:

Case No. 1: June 1961. A 16-year-old boy worked 1 day applying a mixture of sulfur, DDT, and Phosdrin to a 12-acre field of strawberries. A short time later, the boy became nauseated and vomited, and experienced difficulty in breathing. Despite receiving some medical care, he died the next morning. Reports indicated that he died in his work clothes, and no attempt had been made at decontamination. Chemical analysis of the mixture in the laboratories of the State Department of Food and Agriculture showed that the pesticide formulation used contained over twice the amount of Phosdrin indicated on the label.

Case No. 2: 1964. A 28-year-old man was hired and put under the direction of an experienced sprayer. After 3 weeks of training, he was assigned to his first job. He was to spray 40 acres of lettuce with a mixture of parathion, DDT, and Phosdrin. The parathion and DDT were mixed in a closed system while the Phosdrin was poured manually. After mixing, he drove 1/4 mile where he stopped the truck, and began to vomit. He apparently fell out of the truck and landed in a ditch, where he was found dead. He was last seen alive at midnight, and the ranch owner found the employee's body at 8 a.m. the next morning. He had been wearing coveralls and a hooded raincoat at the time of exposure. A post-morten examination found blood and brain cholinesterase levels to be close to zero. An investigator reported a wet spot of soil smelling like Phosdrin where the nurse rig had been, suggesting to him that some Phosdrin had been spilled. A respirator and gloves were found, but it is not known if they had been used.

Case No. 3: 1967. A 36-year-old apprentice pilot overloaded his aircraft against the advice of a coworker. His plane did not clear the runway and crashed, bursting into flames. The pesticides he was carrying, TEPP and Phosdrin, spilled on the pilot. The burns sustained were not critical, and an autopsy confirmed pesticide poisoning as the cause of death. Death occurred within 20 minutes after the crash. No decontamination or removal of clothing had been attempted. No prior arrangements had been made for handling emergencies.

1975 NONFATAL EXPOSURES TO MEVINPHOS

In 1975, there were 66 exposures to mevinphos reported by physicians to the California Department of Food and Agriculture. Of these exposures, 62 were suspected systemic illnesses, 2 involved eye irritation only, and 2 involved skin irritation only. The following is an account of each exposure incident.

Suspected Systemic Illnesses

(Formulation Plant Workers)

Nineteen of the 62 suspected systemic illnesses involved formulators or formulation plant workers. A formulation plant employee had been filling 5-gallon cans of Phosdrin when he became nauseated and started to vomit. The employee could not remember any spill; his blood cholinesterase level had been showing a slow, steady decline during the previous few months. He was taken to a local hospital emergency room where he was administered atropine (2 mg, I.M.). He was given cholinesterase tests and released 4-1/2 hours later. The day after his release he had bizarre dreams and symptoms of nausea, sweating, and vomiting. He returned to the hospital and was given normal saline (250 cc) and Protopam (1 gm, I.V.).

A chemical formulation plant worker had been collecting Phosdrin samples for analysis when he became ill. The sampling procedure had required that he remove container caps; however, when he replaced the caps, he did so without the use of gloves. He was admitted to a hospital, treated with atropine, and released after 2 days.

A formulation worker filling Phosdrin containers started to develop cramps and nausea. This employee had started work in the morning and had become ill after lunch. He was taken to a physician who referred him to a hospital where he was treated with atropine (I.V.). Three days later, upon release from the hospital, he resumed limited work in a no-exposure capacity.

Another formulation plant employee had been filling 5-gallon cans with mevinphos when he became ill, and vomited at work. After a few minutes of rest, he returned to work. After work, he became ill again and was taken to a hospital where he was administered atropine (1 mg). No cholinesterase tests were made. The employee had been wearing all the recommended safety equipment and could not recall any spill.

A laborer had Phosdrin from a rusty 5-gallon can leak onto his face while trying to bring it down from a pallet. He immediately washed and was taken to a hospital where his cholinesterase levels were tested and found to be below normal. After treatment with atropine by injection, he was released and returned to work.

Two men had been working in a formulating plant when they spilled Phosdrin on themselves during packaging operations. Both men had been wearing proper equipment, which probably reduced the effects of exposure. One man was treated with atropine (5 times in less than 2 hours); the other was examined by a physician and released without treatment.

A formulation worker had been working with a machine that caps cans when a hose broke, splashing Phosdrin on his legs. He had not been wearing the required safety equipment. The employee became nauseated, started to vomit, and was taken to a hospital emergency room where he was given atropine. He was referred to a private physician who advised him not to work with pesticides for 30 days.

Three formulation plant employees had been working with Phosdrin for several hours. The men had been wearing all the proper safety equipment, but apparently their respirators were not functioning properly. Later that evening, they became ill and were taken to a hospital emergency room, administered atropine, and released with instructions to return for further treatment.

A formulator became ill after working with mevinphos inside a formulation plant for only 2 hours. This employee, who had worked 3 days a week, had been off work for the past month because of low cholinesterase levels. He had just returned to work, becoming ill on his second day back at work. He was wearing all the necessary safety equipment. The worker was taken to a hospital emergency room, examined, treated, and released.

A formulator was pumping mevinphos into a tank when he was accidently sprayed on his back. He was taken to a hospital complaining that he was sweating excessively and his eyes were twitching. He was admitted into the hospital and treated for an unspecified length of time.

A laborer had been filling Phosdrin containers for several hours when he became ill with symptoms of muscle fasiculations and pinpoint pupils. He was taken to a hospital, examined, treated, and later released. The employee stated that when he was handling the containers, his sleeve came into contact with Phosdrin on the filling spout.

A laborer was repairing machinery that had been utilized to fill Phosdrin containers when he became ill and was taken to a hospital emergency room. He was given repeated doses of atropine (4 times) and released. He returned the next day to the physician with continuing symptoms. He was given 5 more injections of atropine, and released. The employee said he had been wearing all the proper safety equipment.

While filling containers with Phosdrin, an employee developed a headache and became nauseated. He stated that he had followed all the safety precautions and did not know how he had become exposed. He was given repeated doses of atropine (I.V.) by a physician for 2 days and told not to return to work for 2-5 days.

A formulator had been working with mevinphos for 12-16 hours a day for several weeks when he began to notice blurred vision and nausea. He was taken to a physician, given cholinesterase tests, treated, and advised to avoid exposure to pesticides.

A laborer was exposed to Phosdrin (investigative report does not state the circumstances). After showering twice, he was admitted to a hospital feeling weak and dizzy. Cholinesterase tests were made; they showed only a slight drop below normal levels. Treatment was given, and when no further treatment was deemed necessary, the patient was released.

A foreman had been taking samples from some Phosdrin containers without using gloves or a respirator. He accidently spilled some on his hand. He immediately washed and went to a hospital emergency room, where he was examined and later released when symptoms of overexposure developed.

(Mixer-loaders)

Twenty-three of the 62 suspected cases involved workers who mix and load Phosdrin for aerial or ground application.

Five mixer-loaders became ill as a result of a single exposure to mevinphos. Three of the workers were admitted to a hospital, where they were examined and given Protopam (1 gm, I.V.). Two of the 3 workers were discharged from the hospital shortly thereafter, and 1 remained hospitalized for 2 days. After release, they were able to return to work but were instructed to avoid organophosphates for 2-3 weeks. One worker later went to a physician for care and was released, while the fifth worker refused all treatment. The men had not been wearing their respirators at all times.

Two men were working with mevinphos as mixer-loaders when they became ill. They were treated with atropine at a physician's office and released. One of the men returned for care within 4 days with recurring symptoms. They had been working with a rig that pumped the concentrate directly into an aircraft, with the water being added after the concentrate was in the aircraft. There had been no breeze, and it was a hot day. These men, unknowingly, did not have the proper filter elements in their respirators at the time of their overexposure.

A mixer-loader had been working at his present job of loading Phosdrin 4EC when he was admitted to a hospital after complaining of fever, dizziness, and diarrhea. A blood test to determine blood cholinesterase levels was not run until the fourth day after admission. It showed that his cholinesterase levels were below normal. He was then treated with atropine and released. The patient had been working at his present job 13-16 hours a day for the previous 3 weeks. He stated that during this time he removed his respirator between loads. When this was done, he could smell the Phosdrin, and he felt that over a 3-week span, repeated exposure to Phosdrin had been excessive.

A mixer-loader said he had smelled fumes of Phosdrin and Systox while working. He had been wearing all the required safety equipment except a respirator. He became ill later that night and went to a hospital with symptoms of nausea and vomiting. He was hospitalized for 2 days.

A worker had been loading an airplane, and released the hose connection before the plane was completely loaded while there was still pressure in the line, thus spraying himself with Phosdrin. He was admitted to a hospital (length of time not stated) and treated with atropine. The employee had been wearing all required safety equipment; this possibly reduced exposure somewhat when the spraying occurred.

A man had been mixing Phosdrin when he splashed some on his lip and left eye. He soon became ill, with symptoms. He was admitted to a hospital and treated with atropine. The employee had taken off his safety equipment between loads. He was said to have been warned of the potential dangers present when handling all pesticides.

A loader who had been pouring Phosdrin into a mix tank spilled some on his coveralls. He had been wearing all the required safety equipment. He immediately showered and changed clothes. Several hours later, he became ill and went to a doctor, who admitted him to a hospital. He stayed for 2 days and was given repeated doses of atropine.

A mixer-loader applicator had been mixing and spraying Phosdrin. He had been measuring out 4 batches at a time in open containers and was exposed as he had not been wearing the required safety equipment, except for gloves. He was treated in a hospital for 3 days. He was told to return for the next 2-4 weeks for further treatment.

A mixer-loader was loading Phosdrin into an airplane when he became ill with chest pains. He was taken to a physician where he was treated with atropine and released with instructions to return for repeat care. He said he had been wearing the proper safety equipment.

A mixer-loader was filling a tank with concentrated mevinphos when he tripped over a hose, spilling about 2 pints of mevinphos on his leg. The employee had been wearing all the required safety equipment but apparently had been careless. He was washed off and taken to a hospital where he remained for 2 days. His cholinesterase levels were below normal, so atropine was administered.

A mixer-loader's blood cholinesterase levels were becoming slowly depressed over the course of a few months, which indicated a possible chronic exposure to the pesticides he worked with (Phosdrin and Metasystox-R). He was not sure how he was being exposed as he had been wearing the required equipment. The employee was treated in a hospital for 2 days. Upon release, he was told not to return to work for 2 weeks.

A mixer-loader had been working with Phosdrin, Ethion, and Sevin during the day. The employee had been wearing required safety equipment and had not been affected during the day. It was a hot August day, and the employee said odors of Phosdrin were more prevalent than usual. When the job was completed, he began to feel ill and was taken to a hospital for care.

A mixer-loader was working with Phosdrin when he became ill. He was taken to a hospital intensive care unit where he was administered atropine. He was hospitalized for 3 days. The employee had been wearing all the required protective gear. He stated that he had also been exposed to sludge he had cleaned off the mixing tanks.

A loader had been working with DEF and Phosdrin for about 5 hours when he became nauseated and vomited. He left work and went home. Five hours after becoming ill, he went to see a physician who gave him injections of atropine and admitted him to a hospital for 2 days. The employee stated he had been able to smell fumes coming through his respirator cartridges.

A mixer had been working with Phosdrin for about 4 hours when he saw that a truck had overturned in a canal. He removed his protective gear and went to the accident site. At the accident site, he jumped into

the water to pull the body of a man from the submerged cab. After retrieving the body, he removed his wet clothes and put on his work coveralls. Work with pesticides was halted, and on the way home he became ill. He was taken to a hospital where he was admitted for 2 days with organophosphate poisoning. He was treated with atropine and Protopam.

A mixer-loader was unloading an unsealed Phosdrin drum from the bed of a pickup when it slipped and fell to the ground. He did not notice that Phosdrin had splashed onto his knee until he felt a burning sensation. The employee had not been wearing all of the proper safety equipment. He had been furnished with the proper footwear, gloves, goggles, and apron. He was not wearing his apron, which in all likelihood would have covered the exposed spot. After washing the area and putting on clean coveralls, he began to feel ill. He was then immediately taken to a hospital intensive care unit where he was administered atropine. Three days after his release from the hospital, he returned to work where he was given a low-exposure job working in the yard.

A mixer-loader was pouring Phosdrin and Nudrin into his mixer tank when a can fell into the mixture and splashed part of this mixture onto his face, eyes, and hair. The employee had not been wearing his goggles or respirator. There being no clean water provided, he washed in a nearby canal. After washing, he was taken to a hospital where his eyes were irrigated and atropine (2.5 cc) was administered. The day after exposure, his cholinesterase levels returned to normal.

A mixer-loader was working with a mixture of Phosdrin, Fundal, and Dibrom when he became ill with symptoms of nausea, headache, vomiting, and dizziness. By the time he reached a physician, his symptoms were gone. He was released and told to return if symptoms recurred.

(Ground Applicators)

Thirteen cases in 1975 involved ground applicators. Three ground applicators had been working several days for 10-12 hours a day spraying mevinphos. After work, they complained of fatigue and dizziness, and had dilated pupils. All required safety equipment was said to have been used, but the air conditioner filters of the enclosed cabs had been only washed instead of being changed daily. (Washing does not get much Phosdrin residue off filters). It is unclear if the 3 applicators also wore respirators inside the air-conditioned cabs. The workers were treated with atropine and released.

A driver-applicator opened an air vent of a spray-rig, and Phosdrin sprayed out some of the chemical onto his glove. The employee washed and changed gloves but continued working. He became ill, and the foreman took him to a hospital. Cholinesterase tests showed a low cholinesterase level. He was admitted to the hospital and treated with atropine and Protopam.

Two workers had been mixing, loading, and applying Phosdrin over a 2-day period for a total of 7 hours each day. The employees had both been wearing the proper safety equipment. At the end of this time, they complained of illness and were both taken to a hospital. They received cholinesterase tests and were kept overnight for observation. Both men were off work for 4 days.

An applicator had been spraying Phosdrin during the day. He failed to shower after work and later became ill. He was admitted to a hospital for an unspecified length of time and treated with atropine (I.V.). The employee had been supplied with all the necessary safety equipment but appeard not to have used it.

A ground applicator was working with Phosdrin when he became ill. The employee said he had used all the required safety equipment and did not know how exposure had occurred. He was hospitalized for 2 days. The company for which he was working had a fairly good cholinesterase testing program and had been testing this employee every week. The most recent tests had been run 7 days before the illness occurred, and had shown cholinesterase levels below normal.

A driver had been working with Phosdrin and DEF for about 5 hours when he became ill. He was taken to a hospital emergency room where he was given injections of atropine. The employee stated that he had been wearing all required safety equipment.

A sprayer had been applying Phosdrin from 4 a.m. until about 11 a.m., when he started feeling dizzy and began to vomit. He was immediately taken to a hospital where he was held overnight for observation, then released. Prior to this day's spraying, the employee's cholinesterase levels had been close to the minimum legal level.

Another applicator developed a headache after spraying with Phosdrin. This employee had not been using all the required safety equipment. He was taken to a hospital where he was examined, treated, and released without further treatment. The employee had been wearing all required safety equipment and was not sure how exposure had occurred.

The results of a routine cholinesterase test indicated that an applicator was suffering from organophosphate poisoning. He was examined by a physician, treated, and advised to avoid exposure to all pesticides. The worker had been applying Phosdrin and Guthion.

(Flaggers)

Two flaggers for aerial applications of Phosdrin, Lannate and Dipel became ill after working for about 5-1/2 hours. They were hospitalized for 2-1/2 days and were administered atropine. Both men had not been wearing all the required safety equipment; one had forgotten his hat, and the other had not been able to find his respirator. The night of exposure was calm and the mist was hanging in the air, but neither of the men could recall getting wet with spray.

(Field Worker)

A laborer had been hoeing weeds in a field when he noticed a flag truck pull up. He thought that another field was to be sprayed, but, as it turned out, the field he was in was sprayed twice before he could get out. As he was leaving the field, someone told him to wash off the spray (Phosdrin 4 and Lannate L), which he did. That night he began to vomit and suffer severe headaches. He went to see a physician, who treated him with atropine.

(Pilot)

A pilot had been cleaning a hose on a mix tank which had plugged up with sand when he accidently turned the valve on and splashed Phosdrin in his face. He became ill and was taken to a physician's office and administered atropine. The physician estimated further treatment could take 5 weeks and that work disability would range from 4-12 weeks.

(Truck Driver)

A driver for a chemical plant had been unloading a Phosdrin container which had a loose lid when he spilled some Phosdrin on his hands. The employee had not been wearing gloves. He was taken to a hospital emergency room where he was given a shower, treated, and released.

(Loader Checker)

A loader-checker for a shipping company was unloading cans of Phosdrin from a freight car when the top of a can broke. While trying to isolate this can, he spilled some Phosdrin onto his right hand. After washing his hand, the employee went to his supervisor who took him to a hospital, where he was treated and released.

(Disposal Site Worker)

A worker arrived at a dump and was told to separate the glass, metal, and cardboard containers. He was exposed to empty Phosdrin containers. He was taken to a hospital, treated with atropine, and released the following day.

Eye Exposure Incidents

(Mechanic)

A mechanic had been using a high speed pump to transfer a diluted solution of Phosdrin from a leaking mix tank into a retaining tank. The end of the hose in the retaining tank had not been secured in place and, under a pressure buildup, had sprayed a slight amount of the Phosdrin onto the mechanic. Shower facilities were available, so he immediately washed and was sent to a physician who irrigated his eyes and released him. The employee had not been wearing goggles.

(Field Worker)

While picking brussel sprouts that had been sprayed 9 days earlier with Metasystox-R and Phosdrin, a field worker developed an eye irritation. The injury was diagnosed as a chemical burn. The cause of this irritation would be difficult to prove, but the physician attributed it to pesticides.

Skin Exposure Incidents

(Irrigator)

An irrigator was repairing a ditch bank that had flooded. Phosdrin and Nudrin had been applied 3 days earlier by air. The worker developed

a dry, itchy rash over most of his body. He was given medication by his physician and released. Pesticides were suggested as a cause. (Phosdrin has not been known to cause skin problems).

(Field Worker)

A field cutter was cutting weeds two days after Lannate and Phosdrin had been applied to a lettuce field. The injury was diagnosed as acute allergic contact dermatitis. He was given medication and released. Phosdrin has not been established as a skin irritant. This injury may actually have been an allergy to something else in the field.

1976 NONFATAL EXPOSURES TO MEVINPHOS

In 1976, there were 68 exposures to mevinphos reported to the Department of Food and Agriculture by physicians in California. Of these incidents, 58 were suspected systemic illnesses, 7 involved skin irritation, and 3 involved eye irritation.

Suspected Systemic Illnesses

(Formulation Plant Workers)

There were 9 cases of suspected systemic illnesses which involved formulators or formulation plant workers.

An operator had been making a batch of Phosdrin. He had been wearing the required safety equipment until the batch was transferred to a holding tank. At that time, he removed his safety equipment while still in the working area. He became nauseated and was taken to a physician and treated with atropine.

Another formulation worker had been transferring Phosdrin to a holding tank while wearing all the required safety equipment. Exposure probably occurred as the worker removed his equipment to go to lunch. He began to feel ill and was admitted to a hospital intensive care unit. He was hospitalized for 3 days and was off work for 1 additional week.

An employee had not been wearing the required safety equipment while cleaning a pump used in mevinphos production. He was admitted to a hospital with symptoms that included miosis, excessive salivation, and perspiration.

A formulator had been filling 1-gallon containers with Phosdrin. He later became ill with all the usual symptons of organophosphate poisoning. He was given atropine and 2-PAM (I.V.) and told not to return to work for 4 days.

Another worker became ill while packaging Phosdrin. He had been wearing all the required safety equipment and could not recall a specific incident that might have caused the poisoning. He was treated with atropine at a hospital emergency room and released.

A formulation worker was handling Phosdrin when his vision became impaired. It was not known how the exposure had occurred. He was taken to a physician who diagnosed the illness as caused by a pesticide.

A worker stated that he had become ill after mixing Phosdrin in a chemical plant. It was not known how this exposure had occurred. A physician treated him and instructed him to not work with pesticides for several weeks.

A routine cholinesterase check of a chemical operator showed severely depressed cholinesterase activity. The worker had been wearing all safety equipment and was asymptomatic. He was advised to avoid direct exposure to Phosdrin until his blood cholinesterase levels returned to normal.

A worker was repairing the vent lines for a blower in a formulating room when he started to vomit and feel dizzy and weak. He had been exposed to Phosdrin and Metasystox-R. He was admitted to a hospital where atropine and I.V. fluids were administered. The worker was released from the hospital 2 days later and told not to return to work for 8 days.

(Mixer-Loaders)

There were 22 cases in which mixer-loaders were involved in suspected systemic illnesses. One mixer-loader had problems operating a new closed system he had not previously operated. The sleeve on the probe was too small to seal the opening. When the operator flipped the switch to empty the container, the system went into the rinse cycle and splashed concentrated Phosdrin on the operator. He complained of nausea, weakness, vomiting, and sweaty hands. He was hospitalized for 2 days and given repeated doses of atropine.

While pouring Phosdrin into a mix tank, a small amount of the concentrate splashed on an employee's arm and soaked through his coveralls. He had washed the material off about 10 minutes later. That afternoon he began to feel ill. He was taken to a physician and given 2 mg atropine (I.M.).

A discharge hose had been leaking around the hose clamp. Each time the loader turned on the valve, he became exposed to Phosdrin and Lannate. He had been wearing all the required protective gear. Symptoms included miotic pupils, salivation, nausea, and weakness. He was admitted to a hospital for an unspecified period of time and was administered atropine.

Two men were mixing Phosdrin and Thiodan when the recirculating hose on the mix tank broke and sprayed the men in the face. Their clothing was also contaminated. The required safety equipment had been used. Both men experienced nausea, headaches, and blurred vision. They were treated with atropine by a physician and advised to avoid exposure to pesticides for a period of time.

A mixer-loader was attempting to repair a leaky pump when his clothing became contaminated with Phosdrin. Shortly thereafter, he developed symptoms of organophosphate poisoning. He was taken to a physician where he was cleaned up and given atropine.

A worker was handling empty Phosdrin containers after loading jobs had been completed. Late in the afternoon, he became weak and nauseated. He was taken to a physician and treated. He had used the required safety equipment only until the loading jobs were finished.

A worker was supervising loading activities of parathion and, later, Phosdrin. During the course of a day, he came in contact with enough pesticide to make him ill. He was admitted to a hospital for 1 day, where he was given injections of atropine and 2-PAM.

A mixer-loader became ill while driving back to his employer's headquarters. He had been mixing Phosdrin all day but could not recall any specific splashes, spills, or other accidents that could have caused the illness. His symptoms included abdominal pain, vomiting, extreme muscular weakness (he could not walk), loss of memory, confusion, and visual disturbance. He was taken to a hospital and treated with atropine and 2-PAM. The worker was hospitalized for 2 days.

Two workers stated they had loaded Phosdrin into a plane. It was not stated if the workers had been wearing proper protective equipment. Each man was given 3 cc of atropine and told to stay home for 2 days.

While loading an airplane, a worker inhaled Phosdrin dust that had blown onto his face. It was a hot day and the employer said he thought his employee probably was not wearing the safety equipment that had been provided. Symptoms included nausea, constricted pupils, and mild ataxia. A physician gave him atropine.

During a period of hot weather, a mixer-loader became ill. He had been working with pesticides, including Phosdrin and Lannate. He had been wearing the required protective equipment. The worker went to a physician, feeling light-headed and experiencing blurred vision, headaches, and abdominal pain. He was treated and advised to avoid exposure to pesticides until his cholinesterase levels had returned to normal.

No specific incident (spill, exposure to spray, etc.) could be associated with the illness of a mixer-loader, which was diagnosed as organophosphate poisoning. He had been working with Phosdrin and Metasystox-R for several months. The worker said he had been wearing all the required safety equipment. He was instructed to avoid exposure to pesticides for a period of time.

A mixer dropped a bag of Thuricide into a mix tank containing Phosdrin. He retrieved the bag with a stick while wearing the proper protective equipment. A short time later, he began feeling weak and groggy. A physician diagnosed his illness as organophosphate poisoning and administered 2 mg of atropine.

A worker was mixing Phosdrin. He had been wearing all his safety equipment but began to feel ill after work. He was taken to a doctor who administered atropine.

A mixer-loader also operated a pesticide container crusher. He did not always wear proper safety equipment and might have been exposed to Phosdrin although he did not actually handle the containers. He was placed under medical observation and administered 1 mg atropine.

A mixer-loader apparently wearing all the required safety equipment became nauseated and dizzy, and had constricted pupils. His cholinesterase levels were low, so he was hospitalized for 3 days. Treatment consisted of atropine injections.

(Ground Applicators)

Twelve suspected systemic illnesses occurred in a group of workers classified as ground applicators.

Two ground applicators became ill as the result of spills. One man spilled only Phosdrin on his coveralls, while the other applicator spilled Phosdrin, Metasystox-R, and Nudrin on his arm. Both workers exhibited symptoms typical of organophosphate poisoning. They were admitted to a hospital for 4 and 5 days respectively.

While spraying Phosdrin, a worker began feeling very lightheaded and nauseated. He was taken to a doctor who gave him atropine and instructed him to avoid exposure to pesticides for a week.

A ground applicator pulled a hose from under a tractor and splashed Phosdrin on himself. He was treated in a hospital emergency room with atropine and Protopam. He was also ordered removed from exposure to all cholinesterase inhibitors for a period of time.

A ground applicator became ill after spraying with Phosdrin and Dithane M-22. He complained of headaches, and his eyes were twitching. It is not known whether he had been wearing proper safety equipment. He was treated with atropine and was off work for 2 days.

A foreman and 3 employees sprayed cauliflower with a mixture of Phosdrin, Lannate, and Metasystox-R. All recommended protective equipment was said to have had been provided and used. The foreman was hospitalized for 2 days and was given repeated doses of atropine. Three employees also became sick within 3 days while using this mixture.

A ground applicator spilled an unknown amount of Phosdrin concentrate on his coveralls. He did not change clothes until the job had been completed, about 1-1/2 hours later. He became ill late in the afternoon and went to a physician. His symptoms included nausea, vomiting, excessive sweating, and respiratory depression. He was hospitalized and administered atropine and Protopam (1g, I.V.).

While applying Phosdrin, an applicator became ill. He said he had been wearing the required safety equipment. A physician treated him and advised him to avoid exposure to pesticides for 2 weeks.

A tractor driver had been applying mevinphos and phosphamidon for 2 weeks. Part of his rig had broken and required welding. He failed to completely clean the rig before welding and did not wear a respirator while making the repairs. He began to feel weak and tired and was taken to a physician who administered atropine.

A ground applicator had Phosdrin splash under his face shield as he was opening a container. He was taken to a physician who found the worker's cholinesterase levels to be depressed. He was given medication and released.

During a 10-day period, a ground applicator using Phosdrin experienced unusual sweating at night. He had used all the specified safety equipment and said he had not spilled any Phosdrin. He was treated by a physician.

A tractor driver had a 5-gallon can of Phosdrin spill on his thigh. He was admitted to a hospital for treatment for 2 days. He was off work 4 more days.

Shortly after a pilot had taken off with a full load of Phosdrin, the airplane hopper developed a leak. Phosdrin leaked into the cockpit and contaminated the pilot's coveralls and skin. He immediately returned to the landing strip. By the time he reached a hospital, he felt dizzy and nauseated. He was treated with atropine, kept under observation for 3 hours, and released.

A mixer-loader spilled some Phosdrin on his skin while loading his rig. He was found to have low cholinesterase levels and was treated.

(Flaggers)

While flagging, a whirlwind blew a fine mist of Phosdrin spray onto the face and coveralls of an employee. He continued working until the application was finished, when he began to feel nauseated. He had been wearing the required safety gear. The air temperature that day had exceeded 100° F. He was treated with atropine and put on restricted work activity.

A worker had just started to flag a field when the wind shifted and Phosdrin from the plane drifted onto his body. The flagger had not been wearing a respirator. He was hospitalized for 3 days for organophosphate poisoning.

A worker was flagging a helicopter spraying operation when the wind shifted, causing Phosdrin to be deposited on the flagger. He became ill with symptoms of nausea, vomiting, blurred vision, and excessive salivation. He had been wearing all the required safety equipment; however, his respirator might have been contaminated on the inside, as he removed it between passes of the helicopter.

Another flagger became ill from exposure to Phosdrin while working. It was not known whether or not she had been wearing safety equipment. She was treated by a physician. Her blood cholinesterase levels were slightly below normal.

(Irrigator)

A vineyard was being treated with Phosdrin by aircraft application when an irrigator was accidentally sprayed with the pesticide. The irrigator became ill late that afternoon. He was taken to a physician, treated, and released. The worker returned to the physician the next morning and was again treated.

(Equipment Cleaner)

A worker was cleaning a mix tank when the wind changed and blew Phosdrin into his face. He was hospitalized for 1 day with organophosphate poisoning and told to stay away from work for 2 days.

An employee was doing yard work at a shop when he splashed Phosdrin onto his leg. A physician diagnosed his illness as mild organophosphate poisoning. The worker was treated with atropine and Protopam.

(Field Workers)

A field worker was working around a container of Phosdrin, and inhaled the fumes. He began to feel ill with symptoms including vomiting and numbness of his legs. The worker has hospitalized.

Four men working on a farm cooperative became ill while thinning lettuce about 14 hours after Phosdrin had been applied to the field. One man exhibited extreme symptoms that included facial muscle fasiculation, headache, dizziness, blurred vision, and extreme weakness. He was hospitalized for 5 days and administered atropine. The other 3 workers suffered from mild symptoms of organophosphate poisoning. Only 1 of these men went to a doctor; he was treated with atropine 4 days after becoming ill.

A field worker went to a physician, claiming to be allergic to the insecticides (Phosdrin and Lannate) that had been sprayed on the lettuce field. The most recent pesticide application had been completed 2 months before the illness occurred. The doctor's diagnosis was bronchial asthma, and the worker was treated for that illness. Both insecticides break down in a relatively short time. It is probable that this illness was not due to Phosdrin although it had been so classified.

Eye Exposure Incidents

(Mixer-Loaders)

There were 3 incidents of eye injuries allegedly due to Phosdrin in California during 1976. Two of these cases involved mixer-loaders.

One mixer splashed Phosdrin in his eye while pouring the chemical into a mix tank. He had not been wearing eye protection, but immediately washed his eye after the accident. He experienced blurred vision and his injury was diagnosed as chemical conjunctivitis. A physician treated him for 2 days.

Phosdrin splashed into the eye of another worker as he was pouring the chemical into a nurse rig, even though he had been wearing a face shield. He washed his eye thoroughly and went to a physician. He was treated and released.

While packing strawberries, a worker noticed an irritation in his eye. Phosdrin and Benlate had been applied to the field 5 days earlier. His injury was diagnosed as conjunctivitis. The worker was given medication and released. This case was officially classified as a Phosdrin case. Benlate is a known irritant, but, since Phosdrin dissipates quite rapidly, this eye irritation was probably due to Benlate rather than Phosdrin.

Skin Exposure Incidents

A production manager at a manufacturing plant was attempting to repair a pump when he spilled Phosdrin on his hands. He washed immediately and went to a doctor where he was examined, treated, and released. He was advised not to return to work for 3 days.

A field worker reported to a physician with dermatitis after working in the fields. He was treated. The fields had been sprayed with Phosdrin and Metasystox-R in January, 4 months before the injury occurred. Although this case had been officially classified as due to Phosdrin, the skin irritation was probably not due to Phosdrin or Metasystox-R.

A crop production manager entered a field 1 day after it had been sprayed with Phosdrin and Captan. He developed a rash which was diagnosed as contact dermatitis. He was given local medication. Captan is a known skin irritant; therefore, this injury was probably due to exposure to Captan; not to Phosdrin as was originally officially classified.

A worker was cutting lettuce in a field that had been sprayed earier with Phosdrin and Nudrin. He developed a rash on his arms and face, which a physician diagnosed as contact dermatitis. Although officially recorded as dermatitis due to Phosdrin exposure, it is highly unlikely that residues of Phosdrin caused this dermatitis.

A mixer-loader noticed a rash on his forehead and arms after having mixed only 3 loads of Phosdrin and Lannate during a 2-week time span. He had been wearing the required safety equipment. This case seems questionable as a chemical dermatitis case since the employee had also been working around poison oak. A physician treated the dermatitis with Aristocort cream, cool compresses, and an injection of Kenalog.

(Irrigator)

An irrigator was exposed to Phosdrin and Thiodan when an airplane sprayed the materials while flying over him. The worker went to a physician reporting a skin injury as due to pesticide exposure. The final diagnosis was that the skin injury was due to a fungus infection.

1977 NONFATAL EXPOSURES TO MEVINPHOS

In 1977, there were 48 cases of pesticide-related occupational illness or injury that involved mevinphos.

(Mixer-Loaders)

Thirty-two of these cases involved workers who were mixing and/or loading this chemical.

A worker was loading planes without wearing a respirator. He became ill, exhibiting symptoms of dizziness, weakness, and blurred vision. He was hospitalized for an unspecified time and advised by a physician not to work around pesticides until his cholinesterase levels returned to normal. Apparently there was not enough supervision at the airstrip, as this was the second time within a very short time that this worker had become ill.

A loader, complaining of weakness, nausea and vomiting, became ill after loading Phosdrin. The worker did not always wear a respirator because he said it was uncomfortable. He said he had gotten very little sleep the night before. He was taken to an emergency room where he was treated and released.

A worker was moving containers to and from the loading area, and became ill. He was probably not wearing his respirator at all times. Symptoms included nausea, vomiting, and muscle fasiculations. A physician treated him and advised him to avoid exposure to organophosphates for 2 weeks. Proper supervision at the loading site and training in pesticide safety might have prevented this illness.

While mixing and loading Phosdrin and parathion without wearing a respirator or goggles, a worker became ill. Symptoms included nausea, dizziness, and weakness. He was treated and advised by a physician to avoid exposure to organophosphates until his cholinesterase level returned to normal.

A mixer-loader splashed concentrated Phosdrin on his face while hand-pouring the material. He was not wearing all the required safety equipment and became sick; in fact, he had been seen wearing his respirator loosely hanging around his neck. He was taken to a physician where he was treated and advised not to return to work for 3 days.

A worker had just finished loading Phosdrin into an aircraft, and removed his goggles. The plane started to taxi out of the loading area, causing the wind to blow over a can and splash Phosdrin into his eye. He began to feel sick a little later with nausea and vomiting. He was taken to a physician, treated, and advised to rest at home for 10 days.

A mixer-loader became ill after working with Phosdrin. His symptoms included blurred vision, nausea, abdominal cramps, and vomiting. He was advised by a physician to stay away from pesticides for 5 days.

A loader spilled Phosdrin on himself. His symptoms were moist skin, constricted pupils, and difficulty in breathing. He was subsequently hospitalized for 3 days and treated with atropine.

An employee was loading Phosdrin when a pump gasket blew out, causing the material to splash on him. He was reportedly wearing all the proper safety equipment. He was hospitalized for 3 days. The worker was very critical of the condition of the equipment in use, since he had previously been exposed via leaking hoses.

A worker was transferring about half a load of Phosdrin and Thiodan back from a plane to the mix tank at the end of the day. The hoses were leaking, and the chemicals spilled on his coveralls and pants legs. He washed and continued to work. While driving home, he began to feel sick and was taken to a physician. Symptoms included pin-point pupils, weakness, nausea, and vomiting. He was admitted to the hospital's intensive care unit. After his release, he was advised to avoid exposure to organophosphates for 8 weeks. Faulty equipment and the worker's failure to change clothes after exposure led to this illness.

While loading Phosdrin, a worker became ill with symptoms typical of organophoshate exposure. A closed system was in use, but without an approved probe. The worker was reportedly wearing all the required safety equipment. He was taken to a physician and treated with atropine. He did not return to work for 3 days.

A mixer-loader was lifting an open 5-gallon container of Phosdrin to pour it when he slipped on the ground. When the container hit the ground, the liquid splashed onto his upper body. He immediately removed his coveralls and washed. He was then taken to the hospital. By the time he arrived at the hospital, symptoms of blurred vision, stomach cramps, and tightness of the chest were well-defined. He spent that night in the hospital and was released. This incident might have been avoided if a closed system had been in use.

While opening a container of Phosdrin that was apparently under pressure, a worker had the material splash on his face. He was not wearing any head or face covering. Symptoms included nausea, muscle cramps, constricted pupils, depressed heart rate, and diaphoresis. The worker was hospitalized for 1 day.

A worker was hand-pouring Phosdrin into a mix tank. The liquid hit the tank wall and splashed onto the worker's left side. He was wearing an apron, but this did not cover his side. He washed immediately but became ill an hour later. He was hospitalized for an unspecified time and was also off work for an additional 5 days.

While opening a container of Phosdrin, the material splashed onto a loader's leg. He became ill with symptoms of nausea, vomiting, abdominal cramps, and mild sweating. He was treated by a physician with atropine, and released. The worker was 17 years old, under the required minimum age of 18 for a mixer-loader. All safety equipment was reportedly used.

A worker spilled Phosdrin on himself while loading an aircraft. He was reportedly wearing all the required safety equipment. He became ill with symptoms of nausea, dizziness, and moist skin. He was treated by a physician and advised to avoid organophosphates until his cholinesterase returned to normal levels.

A mixer-loader was rinsing containers of Phosdrin. Some of the material got inside his rubber gloves. He later became dizzy and was taken to a hospital. He was hospitalized for 5 days and again for overnight observation when he became ill a week after his first release. He did not wash his hands after he spilled the Phosdrin in his gloves.

While mixing and loading, a worker had Phosdrin and Lannate splash on his arms and under his face shield onto his face. He experienced nausea, vomiting, lightheadedness, and constricted pupils. He was taken to a hospital emergency room where he was treated and advised to avoid exposure to organophosphates and N-methyl carbamates. The employee failed to wear foot protection and, between loads, removed his respirator while still in the loading area.

A worker had been loading Phosdrin when he became dizzy. He was taken to a hospital where he was kept for overnight observation. He was treated with Protopam and atropine and advised not to return to work with Phosdrin for 3 months.

Two loaders and an aircraft mechanic became ill after working with and around mevinphos all day. Symptoms included nausea, vomiting, and stomach cramps. The workers were reportedly wearing all the required safety equipment. Two of the employees were hospitalized.

Ten other mixer-loaders, in separate incidents, became ill after working with Phosdrin. Symptoms included nausea, vomiting, headaches, dizziness, weakness, pin-point pupils, and diaphoresis. Most of these workers were treated with atropine. One person was hositalized for 3 days, and several workers were advised to rest at home for 1 to 2 weeks. Only 1 worker was reportedly not wearing all the required protective equipment. He was not wearing clean coveralls daily. These incidents were associated with minor spills on the skin during loading. Hot weather may also have been a contributing factor.

(Ground Applicators)

Six workers in separate incidents became ill after being exposed to Phosdrin while driving ground applicator rigs. One worker was applying Phosdrin to lettuce with a motorized back pack. He was not wearing proper protective clothing or equipment. He became ill and was admitted to a hospital intensive care unit where he stayed for 2 days. He was given atropine for treatment. The worker claimed that it was too hot to wear the extra clothing. (Phosdrin is too toxic to apply with back-pack equipment.)

While spraying lettuce with Phosdrin, the hose on the spray rig broke, causing a worker to be sprayed. He was taken to a physician, treated, and released.

A spray rig driver became ill while applying Phosdrin to lettuce. Erratic air currents reportedly caused Phosdrin drift to contact his face and eyes. His eyes were watering and pupils were dilated. He was taken to a physician and treated with atropine and Protopam.

Three workers became ill while driving a spray rig containing Phosdrin. Symptoms included nausea, vomiting, and constricted pupils. They were taken to a physician, treated with atropine, and advised to rest at home for 2 days. The employees were not wearing the proper protective equipment all of the time.

(Pilot)

A pilot had applied Phosdrin on alfalfa with the bubble door off for a better vision during the forenoon. By lunch time he became nauseated, and vomited. He was taken to a physician and admitted to a hospital. He was treated and released the next day.

(Flagger)

After flagging for a Phosdrin operation, a worker became ill, exhibiting symptoms of drowsiness, nausea, and vomiting. He was taken to a physician and treated. He missed 10 days of work.

A worker became ill with nausea and abdominal cramps after flagging for an aerial Phosdrin and Dylox application. He was taken to a physician and treated with atropine. He was off work for 2 days.

(Cleaners and Repairers)

A worker was cleaning the equipment after spraying with Phosdrin. He accidentally hit the lever that raises the spray boom and was sprayed on the face and upper body. He became ill with symptoms of nausea, blurred vision, and excessive sweating. He was hospitalized for 2 days and treated with atropine. It is not known if the employee was wearing the required safety gear. He apparently did not immediately wash off the Phosdrin after exposure.

A worker was repairing a spray rig when some of the spray mix dropped onto his arm. The mix contained Phosdrin and Thimet. He immediately washed himself and changed his shirt. About 2 hours later, he began to feel nauseated. He was taken to a hospital emergency room and given atropine for treatment. The worker was advised by a physician not to return to work for 2 days.

(Formulation Plant Worker)

A chemical formulator was mixing mevinphos and splashed some of the liquid onto his face. He was admitted to a hospital with organosphosphate poisoning for an unspecified stay, and was off from work 2 weeks. Further details were not acquired.

(Warehouse Worker)

A worker became ill after cleaning up a Phosdrin spill in a warehouse. He was taken to a physician, treated, and advised not to return to work for 3 weeks. Further details were not acquired.

(Truck Driver)

A truck driver was delivering Phosdrin, and became ill. A container was thought to have been leaking. He was treated by a physician and released.

(Field Worker)

For his lunch, a field worker picked some brussels sprouts that had been sprayed with Phosdrin 2 days earlier. He became nauseated after lunch and was taken to a physician for treatment.

Eye Injuries

A worker was removing a probe from a rinsed Phosdrin container when some of the material splashed into his eye. He was not using a face shield at the time. He was taken to a physician and given treatment.

Skin Injuries

A field worker was harvesting lettuce that had been sprayed with Phosdrin and Dipel 8 days earlier. He developed a rash on his hands and arms. His injury was treated with Benadryl by a physician. Phosdrin largely dissipates in 48 hours on lettuce, and was probably not the cause of this dermatitis.

DISCUSSION

Use experience with mevinphos as an effective pesticide has been very good because of its extremely high toxicity. However, the safety record of this chemical has been very poor. The high dermal toxicity, the use of highly concentrated solutions, and the high volatility at normal field temperatures make the provision of a safe work place by the employer almost impossible while using this product. Recent studies indicate that persons overexposed to Phosdrin develop interference of proper brain functioning before any peripheral evidence of poisoning appears. This has serious implications for pilots. Many pilots refuse to apply this product. A number of licensed pest operators refuse to use it, and very few licensed operators do so by choice. Licensed pest control advisers recommend the product because of its efficacy, and if the pest control operator refuses to apply it, he runs a risk of losing future business of the grower who has been provided with a recommendation that this product be used.

The most serious exposures occur in handling the concentrate. The use of closed system mixing and loading can minimize this hazard and is recommended. The hazard to the ground applicator still remains, particularly at temperatures above 85° F, due to the volatility of the product and its ability to rapidly pass through skin that is contacted by droplets, mist, or vapor. Full protective gear is needed for the applicator (except the pilot) at all times. At temperatures above 85° F, this gear should include air-cooled suiting or an air-conditioned, protective cab for the worker. Very few applicators have equipment available to protect the worker from both the poisoning potential of the pesticide and the heat stress brought on by conventional protective clothing.

The user of any of the insecticides containing mevinphos is faced with a dilemma when dealing with the regulations concerning worker reentry intervals and the preharvest intervals. There are three different sets of regulations that apply to the use of mevinphos; Federal regulations, State regulations, and label statements. This dilemma is illustrated below.

Federal regulations have no specific worker safety regulations for Phosdrin. They do state, however, that whatever is stated on the label shall be considered the regulations for worker reentry.

The California Administrative Code states that no employee shall be permitted to enter a field treated with any pesticide until the pesticide spray has dried or the pesticide dust has settled, unless the employee wears the required protective clothing and equipment. After this period, any employee may enter the field without restriction, except: (1) when the pesticide label specifies a longer safety interval, or (2) a longer safety interval is specified in the Code. Some labels specify no reentry intervals, some specify a 1-day reentry interval, and a few specify 2 or more days. The safety interval specified by the California Administrative Code is 4 days for citrus crops, grapes, peaches, and nectarines. Worker reentry intervals have not been specified for other crops treated with Phosdrin.

Our Department has conducted a series of foliage and commodity residue studies on Phosdrin, especially involving lettuce and strawberries. These studies indicate that no worker reentry to any field treated with mevinphos should occur for at least 48 hours following application to avoid skin contact with excessive residues. These studies also show that commodity residues did not reach tolerance levels any sooner than this.

Several of the labels of products that contain mevinphos are fairly well written as to specifying the hazards and how to minimize them. Shell Chemical Company's labels are among the best. A few of the labels are inadequate; for example: (1) they specify a 1-day preharvest interval for strawberries and lettuce even though tolerance levels cannot be reached in that time, (2) they fail to notify the user that they are working with an organophosphate, (3) they fail to advise that atropine is antidotal, and (4) they fail to convey the message that the user is working with an extremely hazardous chemical. It would be desirable to encourage EPA to prepare a standard set of Phosdrin labels as they did for parathion, and to require that all follow a standard format.

Considering the overall hazardous nature of mevinphos, if it were now being proposed for first-time registration, it is doubtful if we would approve registration. While it remains registered, we should recommend that commissioners, pest control advisers, and growers use Phosdrin only when safer chemicals will not give adequate control.

RECOMMENDATIONS

1. The labels of almost all of the currently available formulations of pesticides containing mevinphos could benefit from revisions. EPA should be encouraged to develop standard Phosdrin labels as they did for parathion.

2. If new products are proposed for registration that contain mevinphos, the hazards of exposure to high concentrations of active ingredients in liquid formulations (particularly in Xylene) and the volatility problems should be carefully reviewed, and registration should probably not be recommended.

3. The registrations of dusts containing Phosdrin should be phased out.

4. All mixing and loading of liquid formulations should be required to be done with closed systems.

5. All reentry intervals should be at least 48 hours in length.

6. Any work at temperatures above 85° F. by ground applicators should be prohibited unless air-cooled supplied air-respirators are provided.

7. Commissioners, pest control advisers, and growers should encourage the use of pesticides safer than Phosdrin if the alternates will give adequate control.

TABLE 1

EXPOSURES TO MEVINPHOS REPORTED BY TYPE OF ILLNESS
AND JOB CATEGORY FOR 1975, 1976 AND 1977 IN CALIFORNIA

	1975	1976	1977	Total
Suspected Systemic Illnesses	62	58	48	168
Mixer-Loader	23	22	32	77
Manufacturing	19	8	1	28
Ground Applicator	13	12	6	31
Flagger	2	4	2	8
Field Worker	0	4	0	4
Aerial Applicator	0	1	1	2
Worker Exposed to Drift	1	1	0	2
Warehouse-Truck Loader	1	0	2	3
Cleaner-Repairer	1	1	3	5
Indoor Worker	0	1	0	1
Other	1	2	1	4
Exposed, not ill	1	0	0	1
Unconfirmed	0	2	0	2
Skin Exposure Incidents	2	6	1	9
Irrigator	1	0	0	1
Field Worker	1	3	1	5
Mixer-Loader	0	1	0	1
Manufacturing	0	1	0	1
Exposed, not ill	0	1	0	1
Eye Exposure Incidents	2	3	0	5
Cleaner-Repairer	1	0	0	1
Field Worker	1	1	0	2
Mixer-Loader	0	2	0	2
TOTAL	66	67	49	182

TABLE 2

NONFATAL EXPOSURES TO MEVINPHOS REPORTED BY DAYS OF DISABILITY FOR 1975, 1976 AND 1977 IN CALIFORNIA*

	1975	1976	1977	Total
Hospitalization (Days)				
1	4	4	5	13
2	12	8	1	21
3	5	3	5	13
4-5	3	2	0	5
6	0	0	1	1
Unspecified stay	4	2	3	9
Period of Disability (Days)**				
None	12	10	5	27
1	3	5	3	11
2	9	9	3	21
3-4	13	6	6	25
5-7	5	6	7	18
8-14	7	3	5	15
3-4 Weeks	2	3	4	9
More than 4 weeks	0	3	0	3
Unknown	15	22	19	56
TOTAL	66	67	49	182

*Days of disability are usually reported as the estimated period of disability by physicians during the employee's initial examination. Previous experience indicates that this estimated period is often understated.

**Period of disability is the estimated period of time that the worker is off work and it includes the days hospitalized.

TABLE 3

NONFATAL EXPOSURES TO MEVINPHOS REPORTED BY MONTH OF OCCURRENCE FOR 1975, 1976 AND 1977 IN CALIFORNIA

Month	1975	1976	1977	Total
January	1	1	3	5
February	2	5	0	7
March	2	6	4	12
April	10	4	6	20
May	12	3	1	16
June	4	4	4	12
July	3	13	5	21
August	10	8	8	26
September	9	11	5	25
October	7	3	9	19
November	5	8	3	16
December	1	1	0	2
TOTAL	66	67	49	182

TABLE 4

NONFATAL EXPOSURES TO MEVINPHOS REPORTED BY COUNTY OF OCCURRENCE FOR 1975, 1976 AND 1977 IN CALIFORNIA

County	1975	1976	1977	Total
Alameda	0	0	1	1
Fresno	16	7	2	25
Imperial	12	8	8	28
Kern	5	12	3	20
Kings	2	2	1	5
Los Angeles	3	3	2	8
Madera	0	1	0	1
Merced	3	1	8	12
Monterey	2	9	8	19
Orange	0	3	3	6
Riverside	8	3	5	16
San Benito	1	1	1	3
San Bernardino	0	0	1	1
San Joaquin	1	1	0	2
San Luis Obispo	0	1	0	1
Santa Barbara	2	3	1	6
Santa Clara	3	0	0	3
Santa Cruz	4	7	1	12
Tulare	0	2	0	2
Ventura	4	1	1	6
Yolo	0	2	2	4
TOTAL	66	67	49	182

TABLE 5

PHOSDRIN PRODUCTS INVOLVED AS POSSIBLE CAUSES OF ILLNESSES AND INJURIES IN CALIFORNIA IN 1975, 1976 AND 1977

Company	Product	Registration Number	Number of Cases 1975	1976	1977
AMVAC Chem. Corp.	Durham Duraphos EM 4	5481-113 AA	2	*1	0
AMVAC Chem. Corp.	Durham Duraphos 400	5481-114 AA	0	*2	3
AMVAC Chem. Corp.	Unknown	Unknown	1	0	0
Bakersfield Ag Chem	Phosdrin 4-E	11369-50037 AA	3	9	0
Blackhawk Chem. Corp.	Mevinphos Insecticide	2498-79 AA	1	2	0
Castle A. L., Inc.	Castle X-4	10972-50147 AA	3	0	2
Costal Ag-Chem	Coastox Phosdrin 4-E	8469-50057 AA	2	2	1
FMC Corporation	Phosdrin 4.0 Miscible	279-1452 ZA	0	5	1
Gowan Company	Mevinphos 4 A	10163-49 AA	2	3	0
Gowan Company	Mevinphos 4 EC	10163-51 AA	5	1	1
Gowan Company	Unknown	Unknown	2	0	3
Helena Chemical Co.	Phosdrin 4-E	5905-60004	1	1	0
Helena Chemical Co.	Unknown	Unknown	0	1	0
Lesco Seed & Chem. Co.	Phosdrin 4-E	11079-50011 AA	4	8	3
Moyer Chemical Co.	Vegephos 4	5967-58 AA	3	1	0
Occidental Chem. Co.	Phosdrin 4 EC	7001-100 AA	0	1	1
PureGro Company	Phosdrin No. 4-E	1202-85 AA	1	0	0
PureGro Company	Phosdrin 4-E	1203-261 AA	0	0	2
Rockwood Chem. Co.	Phosdrin 400	10226-10 AA	1	0	0
Shell Chemical Co.	Phosdrin Insecticide	201-120 AA	3	2	0
Shell Chemical Co.	Phosdrin 4 E.C.	201-289 AA	12	8	13
Shell Chemical Co.	Phosdrin 10.3 WS	201-291 AA	1	1	1
Shell Chemical Co.	Phosdrin 4 Miscible	201-50080 AA	1	0	1
Shell Chemical Co.	Unknown	Unknown	1	1	3
Soilserv, Inc.	Phosdrin 4-E	6973-12 AA	0	0	2
Soilserv, Inc.	Phosdrin 1-Dust	6973-50080	0	1	0
Soilserv, Inc.	Unknown	Unknown	2	0	0
Toxo Spray-Dust, Inc.	Phosdrin Emulsifiable No. 4	11219-50048 AA	0	0	3
Wilbur-Ellis Co.	Phosdrin 4 Spray	2935-167 AA	2	0	0
**Wilbur-Ellis Co.	Lotus Brand Phosdrin 24 EC	---	3	0	0
Unknown	Phosdrin	---	10	18	9
		TOTAL	66	68	49

* Both AMVAC products were listed on one investigator's report.

** This is not available in the U. S.; it is made for foreign export only. The injuries associated with this pesticide occurred in a formulation plant.